
AIR FORCE SPACE COMMAND
WEAPONS SYSTEMS
POLLUTION PREVENTION
AIR FORCE SPACE COMMAND

Weapon Systems Pollution Prevention

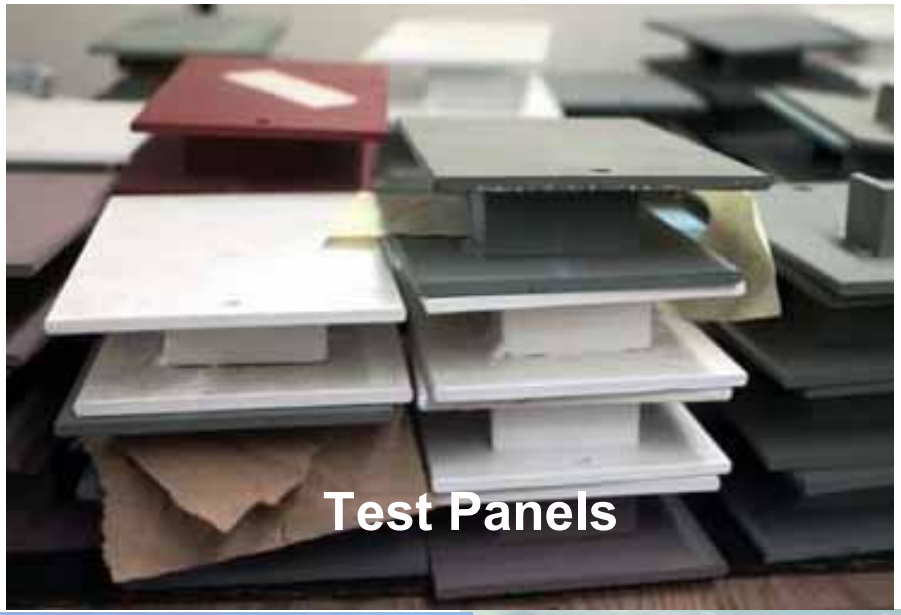
- **Purpose:**
  - **Integrate pollution prevention into weapon systems**
- **Objectives:**
  - **Enhance weapon system performance**
  - **Reduce total ownership costs**
  - **Reduce environmental, safety and occupational health (ESOH) risks / burdens**
- **Scope:**
  - **Identify, research, demonstrate, validate and implement material substitutions and process improvements**
    - **AFSPC Environmental Quality Account (EQA) funds all but implementation**
    - **SPOs / bases fund implementation**
- **Partners: NASA, AFRL, AFSPC/A4, A5, A8, SMC & Wings**

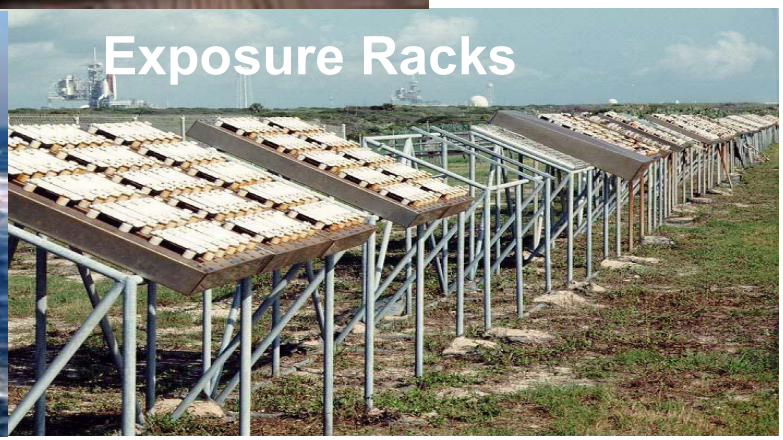
Weapon Systems Pollution Prevention

- **Partnering**
  - **Wings and SMC take ownership of WSP2**
  - **Superb efforts collaborating WSP2 program requirements and status between SMC and Wings**
  - **Outstanding SMC Management Support (Vince Caponpon)**
- **WSP2 program managers are the best in the Air Force**
  - **Leonard Aragon at SMC**
  - **Terry Self at 45 SW**
  - **Kevin Case at 30 SW**
- **How they do it**
  - **Monthly conference calls**
  - **Site visits**
    - **SMC, 45 SW and 30 SW joint visits**
  - **Out of the box program management**
    - **Integrate program management across Wing boundaries**
    - **One Command solving each others problems with integrated program management and common vision**

Weapon Systems Pollution Prevention

Testing of Launch Facility Coatings





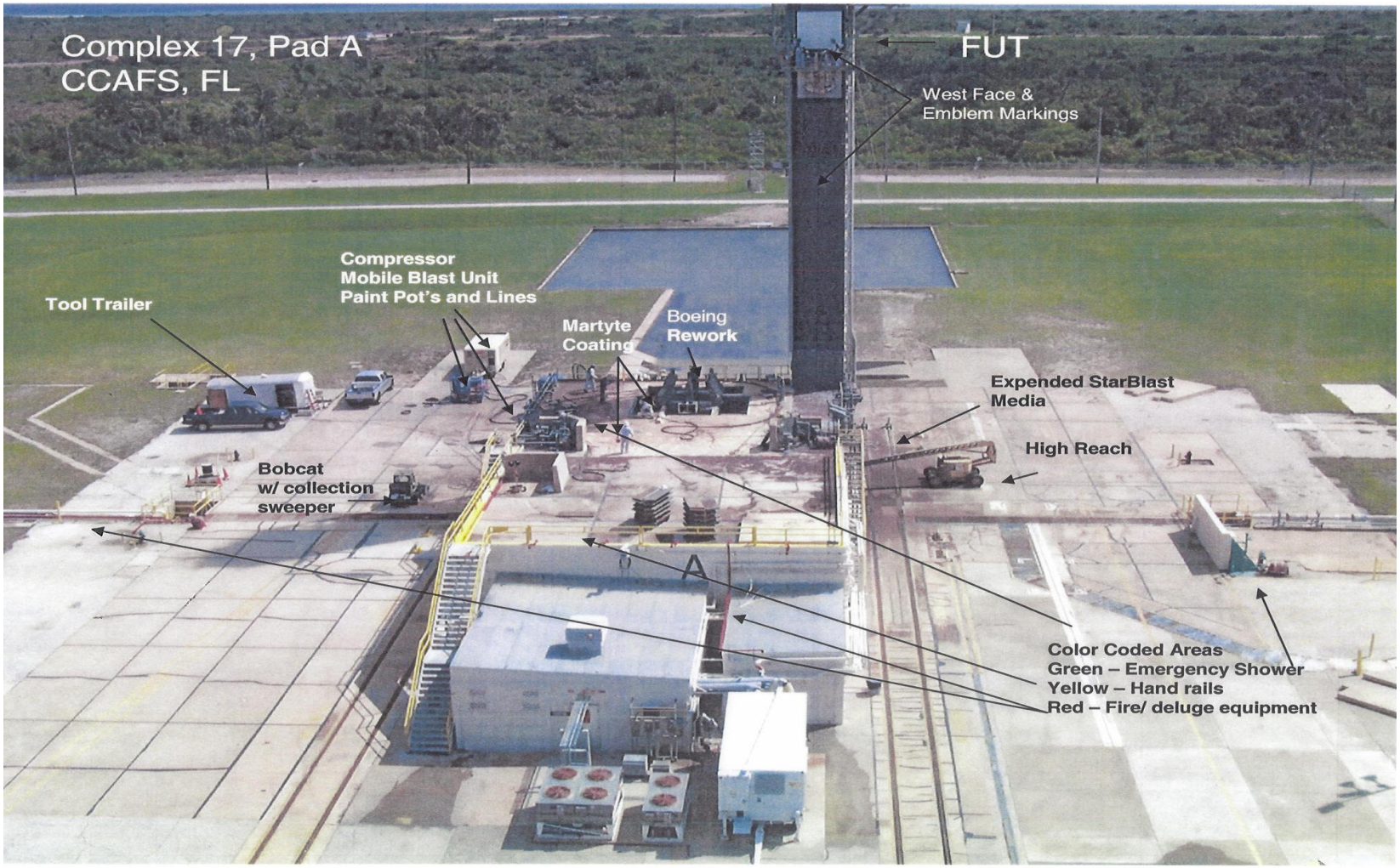
Weapon System Pollution Prevention

Launch Coating

- 30 SW project for Launch Coatings
  - NASA completed Beach Testing on 3 coating systems
    - Two of three coatings passed 18 month beach corrosion exposure tests
    - Coatings are Environmentally preferable systems (Non-chromate, no/low-VOC systems usable in California/Florida for Space Lift applications)
- 45 SW Field Demo/Validation testing in FY07
  - Two coating systems scheduled for testing on active Space Launch Complex

Weapon Systems Pollution Prevention

45 SW Testing of Launch Facility Coatings



ICBM Coating Field Testing

Launch Closure Door & Transporter

ICBM Coating Field Testing

Thermal Spray Technology– Launch Closure

Weapon System Pollution Prevention

ICBM Thermal Spray Program

- **Background**
  - **Thermal Spray (metallization) Coating Technology identified as a replacement to existing outdated/hazardous coating systems**
    - **No VOCs, No Particulates, Minimal worker PPE**
  - **Technology application developed early 1900s. Primary usage are mild strength steels**
    - **Operator application was cumbersome until late 1990s**
    - **Manufactures began to redesign and produce compact units increasing system portability and usability**
  - **ICBM program burdened extensively with large re-work/repair and environmental/occupational health burdens of existing coatings**
    - **Harsh atmospheric environments exposing ICBM launch facilities to corrosion failures**
  - **ICBM/MMIII weapon system active till 2020; evaluation underway to extend to 2025**

ICBM Thermal Spray Program

- **Background (con't)**
  - **HQ AFSPC/WSP2 Program (A7) & Corrosion Control Program (A4) initiated the evaluation of "thermal spray" technology application to ICBM program**
  - **Sub-scale and laboratory program initiated with support of AFRL**
    - **Developed Test Plans**
    - **Verified Corrosive Protection properties, Environmental & Health Benefits, Sustainability and Life Cycle costs**
  - **Developed comprehensive organizational approach with SMC, SPO, 20th AF, Wings (Shops), Prime Contractor to obtain buy-in on technology**
  - **Sub-scale tests revealed conservative 20 year life in corrosive coastal environments**

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ICBM implementation of Thermal Spray Coating

- Field Testing – Demonstration/Validation
  - Dem/Val Test Plan developed and approved by 20th AF, SPO, Prime Contractor, AFSPC/A4, AFRL, 576th
    - Hot LF at VAFB was approved for testing of coating system
  - Coating exposed to actual launch gases & coastal corrosive environment
  - 20th AF, SPO, Prime Contractor, AFSPC/A4, AFRL reviewed exposure
    - No degradation of metallized coating after launch gas exposure
    - Versus, Current coating system completely fails and requires replacement prior to next test launch
- Way Ahead - Wing use authorizations
  - VAFB contract for metallization of top-sides at VAFB LFs
  - Conduct Nuclear Hardness & Survivability Evaluation
  - Conduct Frequency Emission Testing

AFSPC - AFMC Joint Project

ICBM Transporter

AFSPC AFMC Joint Project

ICBM Transporter Demo/Valid

- Field Demo/Validation will evaluate No & Low VOC, non-chromate coatings
- SMC/SPO approve test plan
- Field application on actual transporter FY07

ICBM Equipment Refurbishment at VAFB

Missile support, Shock isolation, Alignment System (MSS)

ICBM Equipment Refurbishment at VAFB

Ballistic Actuator

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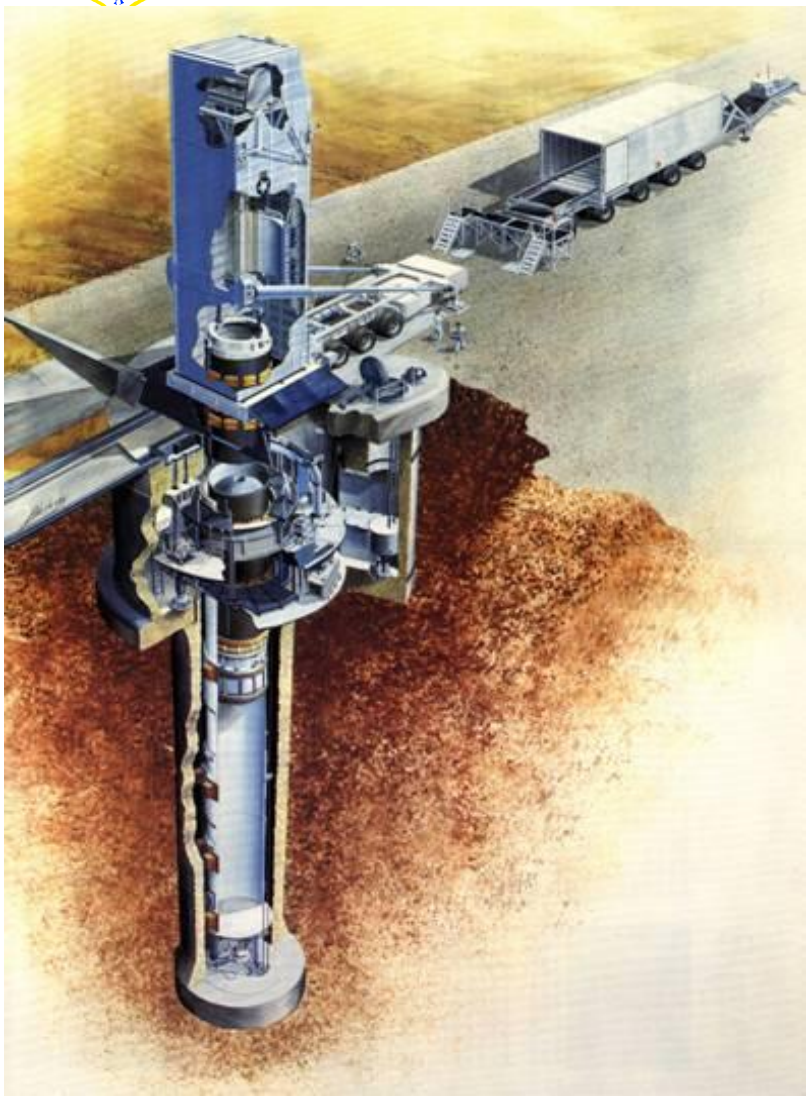
Demo/Valid Kinetic Energy - Cold Spray Technology



Weapon System Pollution Prevention

Internal Ohmic Value Recovery (IVOR)

- Uninterruptible Power Supplies (UPS)
  - Utilize Valve Regulated Lead Acid (VRLA) absorbed mat batteries
  - Single cell – 1000's installed per location such as AF Satellite Control Network Stations at Onizuka and Cheyenne Mtn.
  - Current Battery Life of 5-7 years
- IOVR technology claims to restore capacity and extend useful life through rehydration and insertion of catalyst vent cap
  - Philadelphia Scientific Battery Research & Testing
  - Process catalyst removes excess oxygen
  - Permits negative plate to recharge
  - 12 battery strings under testing at Onizuka

Weapon System Pollution Prevention

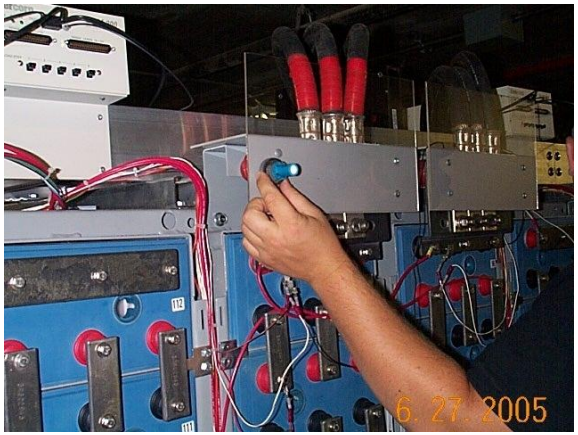
Internal Ohmic Value Recovery (IVOR)

- **Existing Battery Condition tested IAW IEEE Standard 1188**
  - **Internal Ohmic value recorded**
  - **Replaced cell water lost through off gassing and re-saturating of the mat**
  - **Perform Insulation Breakdown Test**
  - **Replace Vent Caps**
  - **Pressure Test Each Cell**
- **Install Catalyst Vent Assembly**
  - **Baseline battery terminal, individual cell voltage & Ohmic values**
  - **Reconnect Battery String**

Weapon Systems Pollution Prevention

Internal Ohmic Value Recovery (IVOR)

Onizuka SCNA battery string BDS T7-1



Catalyst cap

Catalyst Cap installation

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Hypergolic Microwave Scrubber

Hypergolic Storage Facility

Hypergolic Storage tanks

Transfer Operation

Lab Microwave Scrubber

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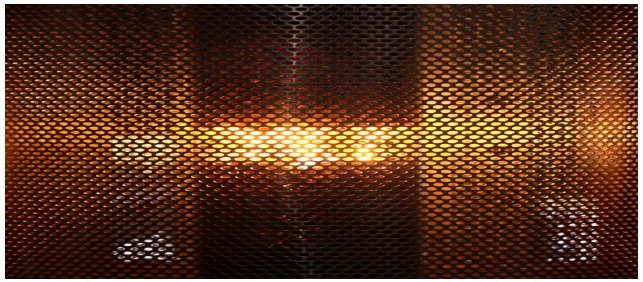
Demonstration/Valid Hypergolic Microwave Scrubber

- **N2O4 system installed at VAFB**
  - **System Safety Analysis Complete & Approved**
  - **1st Automated Controls installed at HSF**
  - **On-site operational procedures in-place**
  - **Regulatory Agency approval received**
  - **1st on-site operational test CY06 with support SMC/Aerospace Corp**



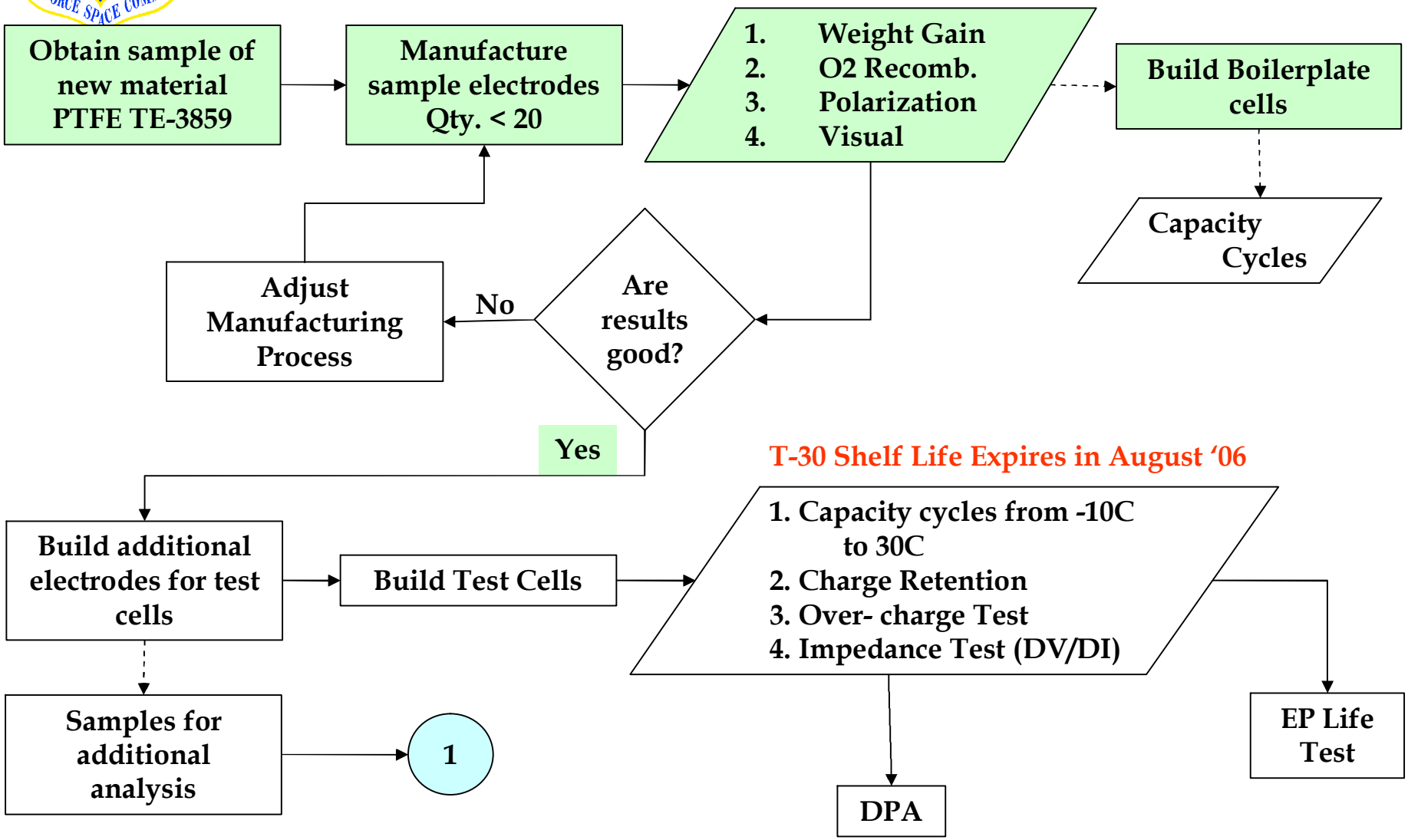
Teflon PTFE T-30 Dispersion

- Currently PTFE T-30 dispersion is used in the manufacture of NiH_2 negative electrodes
  - T-30 is 60% polytetrafluoroethylene, 6% Triton X-100 (an alkyl phenol ethoxylate wetting agent) and water
  - It is used as a binder in platinum mix
  - It is also used as a binder between the GORTEX back and substrate
- Understanding of change
  - PTFE TE-3859 is the replacement material
  - New material will have lower levels (< 50 ppm) of perfluorooctanoic acid (PFOA)
  - PFOA is a catalyst used in the manufacture of TEFLON and is now classified as an environmentally "bad" material
  - Triton X-100 wetting agent will be replaced by an undisclosed blend of DuPont's own linear alkyl ethoxylate Tergitol line of wetting agents
- Evaluate changes with respect to our use of the product in NiH_2 negative electrodes
  - Opinions: PFOA does not change TEFLON
  - Wetting agent is "removed" from electrode during sintering
  - New wetting agent actually vaporizes at a lower sintering temperature

Teflon PTFE T-30 Dispersion

- **Current status**
  - **T-30 is no longer available**
  - **Suppliers have a limited quantity on order**
  - **Shelf life of T-30 is 6 months**
- **This line of DUPONT dispersions is used by several missions in the manufacturing of electrodes**
- **An outline of the NiH_2 Plan is presented in the next view graph**

Evaluation Flow Chart



Evaluation Flow Chart

1

12 Heritage Electrodes (T-30)
12 New Electrodes (TE-3859)
All Other Materials from the Same Lot
Same Operator
Two Virgin Screens
Different Sinter Runs

1. Weight Gain
2. O2 Recomb.
3. Polarization
4. Visual

Deliver Electrodes Independent Lab for Test and Evaluation

Macroscopic Physical Properties
Density, Thickness, Adhesion of Pt black, Hydrophobicity, Surface Morphology

Chemical Properties
Inorganic contaminants
Organic contaminants
Pt solubility

Electrochemical Properties
Overpotential as a function of rate for the evolution and recombination of hydrogen
Overpotential as a function of rate for the evolution and recombination of oxygen

Microstructural Properties (SEM imaging)
Interfaces between the Pt-black and the nickel screen
Interface between the Gortex backing and the nickel screen
Thickness variability
Size distribution and uniformity of Pt

Environmental Programmatic Risk Tool

- **NSS03-01 and DoD 5000 drive PESHE requirement**
  - **Environmental Programmatic Risk Tool developed to identify early in the program Environmental and Occupational Health Risk**
- **Program Assessment is accomplished by the Program Office and will focus' with questions regarding environmental impacts of system**
- **Computer model generates risk assessment by environmental media**
- **SMC effort underway to standardize tool across SMC acquisition programs**

Weapon System Pollution Prevention

AFSPC NASA Joint Efforts

Launch coating test facilities

Laser Coating Removal System

Green Rocket Propellants

Launch coating containment system

Isocyanides elimination

Lead Free Solder

Teflon reformulation

HQ Air Force Space Command

Defenders of the "Ultimate High Ground"